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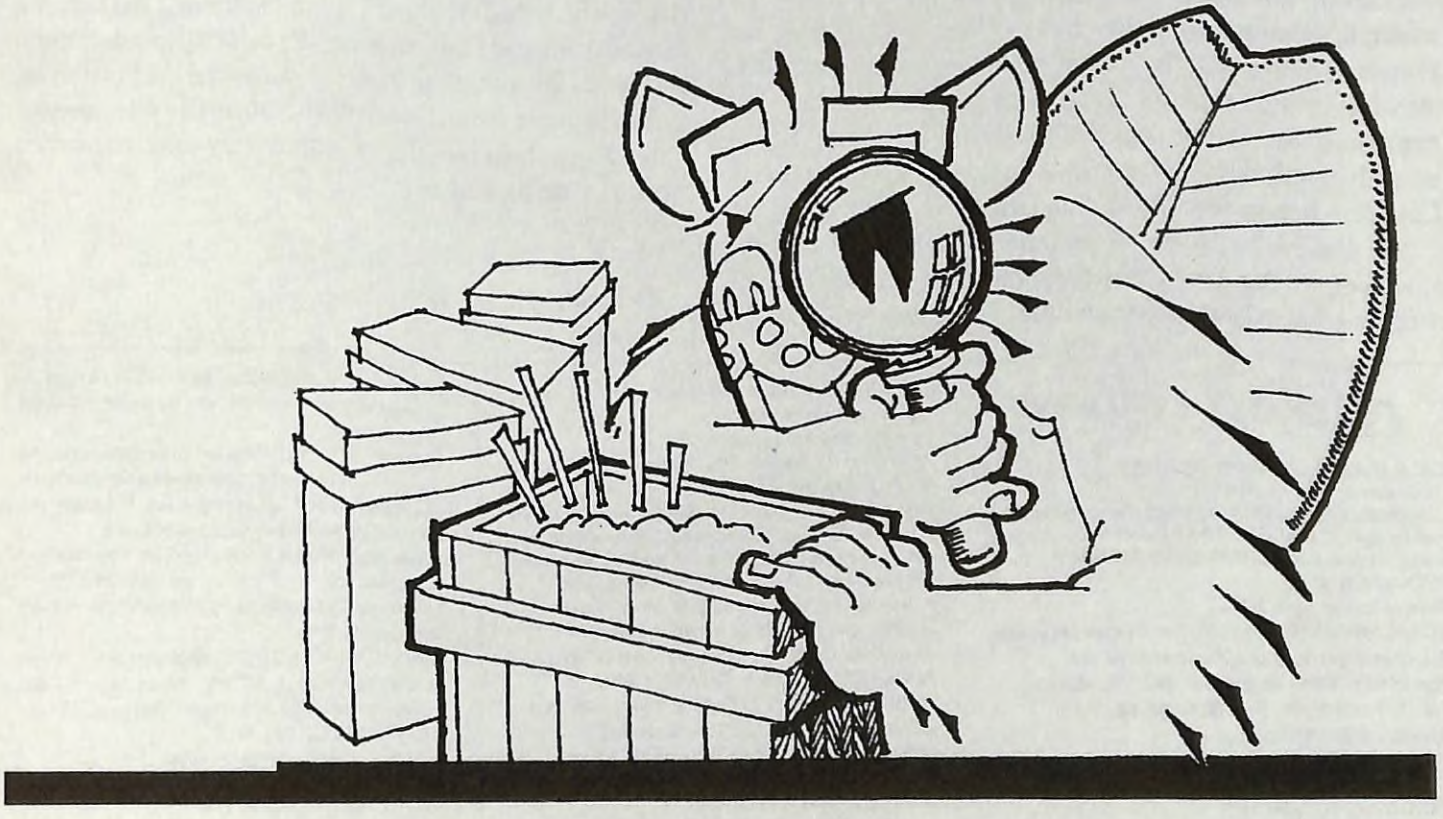
Case Studies



From the Editor . . .

One of the pleasures of publishing Solplan Review is having a good vantage point on the state of the building industry. Many other publications, notices, press releases and e-mail messages land on my desk. Those who know my work habits will realize that I don't exaggerate when I say I'm swamped in paper! However, it is not the size of the mountain of paper is of interest, but the messages the mountain contains.

What struck me recently are the strides being made in the United States toward more energy efficient housing. Today there are many programs in various regions that have taken a lesson from our R-2000 New Home program, and have applied them to their location. Some programs are sponsored by utilities, others by local homebuilders associations, individual companies, or groups of companies.

These moves are being taken in the context of a deregulated energy market, and in some of the most conservative economic environments found anywhere in the world. Despite the wishes of their building industry, the Americans do have more energy regulations in their building codes than we do. However, the programs I am speaking about generally go far beyond code minimum. Simply put, they are seen as a marketing advantage for those who follow them. Claims and warranties are being made that make one shudder - for example, guaranteed utility bills. When you look at the proposed standards, they seem common sense. Canadians may feel smugly superior, as so many program elements and approaches are carbon copies of the R-2000 program. Unfortunately, (and contrary to common perceptions) not that many Canadian homes meet those standards!

We should be proud, as imitation is a form of flattery. However, as the Americans come on strong in the realm of energy efficient healthy construction, the reality is that we are in danger of losing our competitive edge. Not just in the US. When Canadian companies make their pitch in other countries, the R-2000 standard is a welcome calling-card that opens doors. People in other parts of the world want the benefits of such quality homes.

R-2000 has been responsible for much of the education and technology development made in our building industry. In that way it has been a positive influence. There is no doubt that the program has spurred innovation in the building sector. But we may have become complacent. It seems to me that more lip service is being paid to the merits of R-2000 than concrete action being taken. The numbers of certified R-2000 homes are small. Even the much vaunted R-2000 "clones" may not be as numerous are we would like to think.

To their credit, the Canadian Home Builders' Association has been a strong advocate of the program. Unfortunately, this support may have been simply to stall regulatory action. But unless there is real activity, and more homes are built to R-2000 standards whether or not they are certified, we may well see governments press for mandatory actions as a way of meeting Kyoto commitments.

We should take a take a page from our neighbours to the south and find creative ways to generate activity. We should not just focus on dollar-saving energy features of R-2000 - but look at the positive benefits that homeowners receive. Homeowners should be given a presentation of the benefits they can gain, and be given every opportunity to select these upgrades. Houses built to these standards can legitimately be said to be healthier and more environmentally responsible.

Let's give homeowners the opportunity, and encourage them, to make the choice.

Richard Kadulski,
Editor

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Case Studies:
Learning From the Past

Experimentation and investigation is the essence of scientific research. This is fine for small industrial items or individual products, but is not appropriate in the building sector. Most customers do not appreciate paying in full to be the subject of experimentation, yet this is what in fact happens. However, whether we and our customers realize it or not, most buildings are built as prototypes, each a unique specimen never to be repeated, regardless how well it turns out.

Unfortunately, the building industry is not structured to be able to investigate past projects. Designers and builders do not go back to a project unless there is a problem to fix - and then the problem probably has to be a big one before the owner complains. It is only when major problems emerge in several buildings that investigative action takes place.

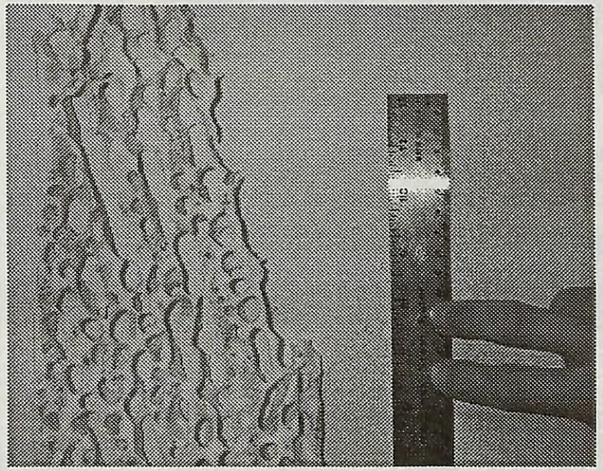
We can learn a lot from past successes and mistakes. Even a small amount of investigation can tell us much. That is why we have assembled several case studies in this issue. All the examples shown are real, but not all have been identified because the point is not to point fingers or lay blame, but to show what can happen, perhaps discover why, and hope that similar problems can be avoided in the future. Lessons can always be learned from our past efforts.

Exterior Foundation Insulation

Insulation of foundations is desirable, especially as most basement areas are now part of conditioned space. In residential construction, interior foundation insulation is the most common approach. However, exterior insulation is also beneficial. In fact some construction techniques include insulation both inside and outside the basement.

The environment in which the building is located must be considered. We do not pay enough attention to the critters in the ground that can compromise the best detailing. This example is a case where extruded polystyrene insulation was applied to the outside of the foundation. However, it was in an environment where carpenters ants were present and quickly discovered the foam insulation. The ants did not eat the foam, but used the space as a nesting ground. The colonies were sufficiently large that they could decimate the insulation.

What makes this case interesting is the locale. This was not in the rainforest of the BC coast, nor in the humid southeastern USA, but in Whitehorse, Yukon.



Remains of foam insulation applied to the exterior of a concrete foundation

The Solar Peep Show

This is a marketing exercise for Thermotech Windows of Ottawa. However, it gives us a chance to look at the basics of passive solar design and to gain insights in building performance, especially the potential contribution of solar energy to a real life situation.

The solar peep show is a real-time monitoring of a recently built seasonal cottage north of Toronto. The unoccupied dwelling has been equipped with instrumentation and shows how solar energy can heat a building in cold climate winter conditions.

The house is insulated to typical cold climate insulation levels, and was not built to the most stringent R-2000 airtight construction detailing.

basement floor	R-7
basement walls below grade	R-15
basement walls above grade	R-30
frame walls above grade	R-30
ceiling - mostly cathedral	R-40

The windows used are not the company's top of the line high performance windows - they are only double glazed, low-e, argon gas filled with an insulated spacer. In addition, one large window has been recycled from the owner's permanent house (clear double glazed with a metal spacer) and the sash is warped open with a space up to ¼".

Information:
Stephen Thwaites
Thermotech Windows Ltd
Ottawa
(613) 225-1101
www.thermotechwindows.com

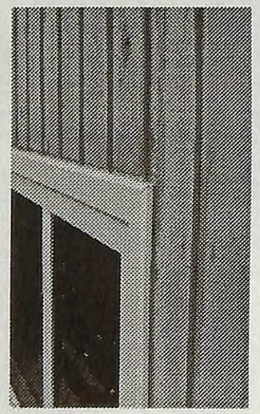
The house is found in an area with more than 5000 heating degree days (°C), with temperatures as low as -30 °C. It was not sited for maximizing solar gains, and it gets a lot of shade. Only about 50% of the available solar energy falls on the windows.

Most houses, left unheated, cannot carry their daily solar gain in a cold climate and can freeze up. This house wasn't built to be furnace free or even freeze proof, but the evidence shows that it is very nearly freeze proof even in a cloudy cold climate. The average interior temperatures are above the average outside temperature by more than ten degrees C with no significant source of heat other than the sun. Although the windows do provide solar gain, this house would be warmer if it were on a better site and with better windows. This case shows what the combination of winter sun and windows with low-e, argon and warm edge spacers can do.

The moderate temperature swing is somewhat related to the better windows, although by today's standards the windows are not that good. They are better than what is found in most summer homes but not as high performance as suggested today for a passive solar home, which would include triple glazing with at least 1 low e (2 on the north). To establish optimum window type, a computer calculation should be done.

As for the payback for higher performance windows, Stephen Thwaites of Thermotech Windows has the following comment:

"I call payback the "p-word," because I don't like to hear it. I hope that no one has ever bought our windows based on payback. We don't promote our windows on that basis. If you were serious about payback, you would follow the code minimum glass areas and U-values and be done with it. But you wouldn't have much of a home, passive solar or otherwise. To me cold climate passive solar means using triple glazed windows with low-e, inert gas fills and insulating spacers. However, our windows are justified on enhanced comfort issues. Window selection cannot just be done on the energy cost savings, although they are there."

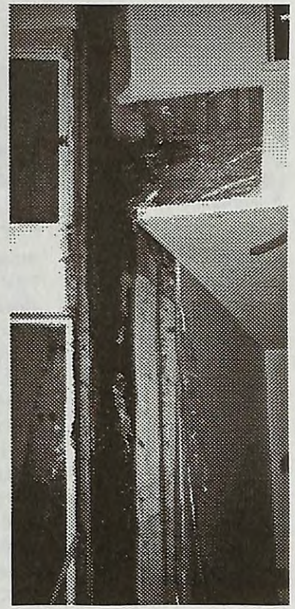


Window Installation

Many people still don't quite get it: you have to install windows properly. This includes proper flashing above the window. As this picture shows, there are still installers that believe in caulking as the magic goop that will provide the needed waterproofing.

This replacement window, installed using a common practice, was surface mounted, with caulking the only waterproofing. Obviously, vertical siding presents challenges for window flashing installation. However, caulking is not a long term, durable detail.

Leaky Houses



By now, everyone in Canada has heard about the catastrophic situation with wood framed multi family dwellings in Vancouver,. This is also known as the "leaky condo" crisis. Unfortunately, the same problems can affect small single family houses as well as larger projects. In single family houses, the impact of problems is often not obvious.

The owner of a single family house has to contend with the consequences without benefit of the support available in multi family condo projects. And the consequences of screw-up ups can be devastating.

The photo shows a new house. The picture shows the end of a glulam beam and was taken five years after the house was built. In that space of time, one foot at the end was completely eaten away by wood rot. By the time the problem was discovered, the drywall that covered the beam had become a major structural element, because the rotten beam was carrying an eight-foot wall above and a roof deck.

The end of the beam was tied into the exterior wall, which was finished on the exterior with an acrylic stucco (EIFS - exterior insulated finish) over expanded polystyrene. The house was a flat roofed contemporary "box" with no overhang. The beam rested on the exterior wall at a point where a small bay window, also with a flat roof and no overhang, joined the wall. The outside wall was the side facing prevailing storms.

Evidently what happened was that the bay roof detail was not adequately detailed - there was inadequate flashing and roof drainage, so water could pond on the roof. The water ponding on the roof could move behind the stucco. Because the acrylic stucco was marketed as a face-sealed product that provided waterproofing, the water that managed to enter the wall had no way to escape. As a result the entire exterior wall had to be rebuilt, since evidence of water damage was found in other sections as well.

The Lesson?

Water by far is the most serious agent that acts on buildings, no matter how they're constructed. Not all climates have conditions that are as severe as Vancouver, but water is always a problem. Designers and builders must keep in mind that water will always find its way into a structure. The challenge is to design and built an assembly that provides a durable, energy efficient result, in a way that will handle water by allowing it to drain away and dry the assembly.

The Leger House: an Affordable Super Insulated Home

Building a low energy house that does not need a furnace is easy and can be done economically. We are presenting Gene Leger's house because it shows what can be accomplished in a low-tech way.

Leger's objective was to build an energy efficient house in a cost-effective manner that, if possible, would not need fossil fuels for heating. What is interesting is that the house was built in 1978 by an individual builder on his own account, without outside incentives or participation. He managed to do this not once, but repeatedly, and has incorporated lessons from this project in subsequent homes.

When he was planning his first super-insulated house, Leger was unaware of the Saskatchewan Conservation House, the first, high profile super-insulated house built in 1976. However, he did know of the Arkansas house, which was a simple yet sophisticated example of advanced wood frame construction. It is the Arkansas house that first reconsidered wood framing and showed what we know today as Advanced Framing.

Leger's house is a one storey 1200 ft² ranch-type house with a full basement located in Pepperell, Massachusetts. The main floor includes a kitchen-dining room, living room, three bedrooms, a bathroom, and two air-lock-type (vestibule) entrances. There is no garage.

The house was built on a cast-in-place concrete foundation, with one inch of styrofoam on the exterior of the North, South and West sides.

Framing took advantage of Advanced Framing techniques. Solid headers were replaced with insulated box beams (called plywood headers in the Arkansas house). Exterior walls were a double 2x4

Northwest view

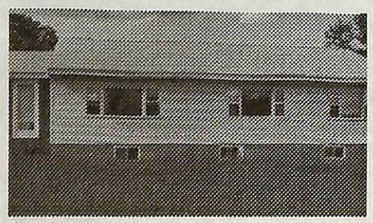
stud wall, with staggered studs spaced 24" on centre, on separate plates forming an 8-inch thick wall. The walls were filled with cellulose insulation. The exterior sheathing was Dow Styrofoam, over which vinyl siding was installed. Leger was very conscious of the need to address thermal bridging, which is the weak point in conventional framing.

The outer wall was placed on the sill plate, but unlike conventional balloon framing, the floor joists did not connect to the exterior studs. The floor joists and subfloor plywood were set back from the edge of the foundation by the width of the outside wall plate, plus a half inch or so. Thus, the outer wall did not touch the platform at any point. However, both walls were were connected at door and window penetrations. Where there was a long wall section without windows, the two walls were tied together every 6 feet. Because of separate top plates, the wall insulation was continuous with the ceiling insulation.

Windows were wood framed double glazed, a combination of casement, double hung with storm windows and sliding units. The gap between the rough opening and the windows and doors were sealed with urethane foam. Total window area is 153 sq. ft. Of this, 100 sq.ft. is on the south side.

The roof was clear span trusses The bottom chords were cantilevered 24" past the outer walls to allow for more insulation over the double top plate and to eliminate the outlooks. The attic had 10" of sprayed-in cellulose, for an R-value of R-30 to R-35.

The clear span roof truss design gave the freedom of an open interior. As a result, a continuous and unbroken ceiling vapour diffusion retarder, drywall and oak flooring was installed without interference from partitions. Partitions were installed after the ceiling and floor were installed.



South side

No wiring was put in the ceiling, so there was no need for penetrations of the top plates of the partitions. All lighting fixtures were placed on the partition walls. The bathroom exhaust fan was mounted in the interior wet wall and vented downward and out through the joist header. The only penetration of the ceiling gypsum and vapour diffusion retarder was the vent stack.

No wiring or plumbing was put in the exterior walls. Conventional wall outlets were replaced with a surface mounted system called Electrostrip. All electrical connections were made on an inside wall. Surface mounted wiring is an aesthetic judgement. It offers flexibility, but is visible and may not be acceptable to everyone. The strip was painted in wall-matching colour to be inconspicuous.

Insulated steel doors, with magnetic weather stripping opened to two airlocks. The wisdom of the day - which persists to this day - said that airlocks were a necessary part of an energy efficient house. However, Leger discovered that the claim that air-locks or vestibules are necessary may not always be correct. He points to tests done on an energy efficient house in Minnesota which found that no matter how often a front door was opened and closed there was no significant air change. What is more important, neither did the occupants notice it being any colder. On the other hand, airlock vestibules in leaky, poorly insulated houses are beneficial.

Domestic hot water and space heating was provided by a tankless 43,800 Btu/hr Paloma natural gas heater. An insulated hot water storage tank with a heat exchanger provided hot water for heating and washing. The water was kept at 160°F and supplied to forty-six feet of baseboard.

A small conventional air-conditioning device was installed in July 1979 and, during that summer, was used only for 12 hours in all. During most of the hot summer days the rooms remained satisfactorily cool (80° or below) if doors and windows were kept shut and shades drawn.

The first blower door test of the house showed 8 air changes per hour because the cellar door to the outside was quite leaky; one of the basement windows was open; and one wall of the tub/shower had not been sealed to the interior partition. Caulking and a few hours work to seal brought the air change down to less than 1 per hour.

A heat recovery ventilator was not installed initially. In hindsight, it is easy to understand that lack of ventilation would be the reason they had high humidity problems (the relative humidity was in the 70 to 80% range). On a sunny February day, when outdoors it was -28°C, they opened all the south-facing windows and left them open for 6 hours. The humidity had dropped to 40% but the house had not cooled off. Before Leger moved out of this house, he did install a heat recovery ventilator.

How well did this house perform? An indication was noted when the house was still under construction. As work was nearing completion at the end of February 1978, they turned on a kerosene heater and got the interior temperature up to 16°C (60°F). The heater was turned off at 2:30 in the afternoon. The next morning, the interior temperature was 5°C (40°F). The house had gone unheated for 18 hours, while the outdoor temperature had dropped to -25°C overnight. Later that afternoon the temperature in the south side living room was 57°F in the shade (without any added heat). The heat was not actually turned on until December.

Because of the super-insulated construction, it was not always necessary to leave the thermostat set at 70°F. The higher humidity, warmer wall surface temperatures and lack of drafts meant temperatures of 70°F or higher were unnecessary to maintain comfort. An average daily temperature in winter could be maintained at 60°F. Most houses can't be kept at that temperature and be comfortable.

Did this approach work? The double walls may be brute force, but the heating bill was $38 for the year.

The house was built at a time when a lot of pioneering solar design was being done. Solar purists wanted Leger to increase the area of south facing windows. Of course, they said more thermal mass would also have to be added to handle the temperature fluctuation and provide for thermal storage. Others claimed that the house could not possibly perform well because it did not have shutters.

Although the Leger house requires more types of construction material, this is largely offset by large savings iother materials. The biggest savings is in the heating system where a furnace is no longer necessary and the extent of the baseboard is drastically reduced. Additional savings result from reduced material and labour requirements for the electrical wiring.

Leger calculates that the cost of the extra wall, added wall and ceiling insulation, and the foundation insulation was offset by the savings gained eliminating the masonry chimney and the lack of a full heating system. After one winter, he realized that he could have eliminated all but 14 feet of the 46 feet of hot water baseboard. Temperatures in every room of the house and from floor to ceiling were similar. A heat distribution system was unnecessary.

. . . the heating bill was $38 for the year.

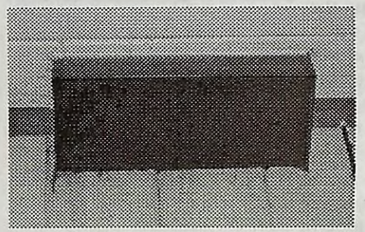
Leger's experience from this house and later work shows that a single point source of heat may often be enough. A house he built in New Hampshire had an 18-foot high vaulted ceiling and was heated by a small wood stove. The temperature difference between the floor and the ceiling was 3°F.

As a builder, Leger has continued to search for alternative construction approaches for cost effective super-insulated homes. He has considered a lighter version of the double wall, using 2x3 studs staggered 24" on centre (600mm), on a 2x6 plate. However, this is limited to single storey houses.

To obtain better insulation levels, he now uses sprayed in polyurethane insulation in spite of its high cost. Polyethylene insulation eliminates the need for several cases of caulking, rolls of polyethylene and the labour to install them. One 1800ft2 house built this way, in New Hampshire, used electric heat at the owner's insistence. A separate meter was installed to monitor electric consumption for heating. The house is in a 7000-degree day climate, but used 2000 kW for its annual electric heating bill (at $10/kW) of $200.00.

Leger has since abandoned the double wall. However, he has not abandoned the search for economical ways to build well-insulated structures. He maintains that first cost must not be an end in itself. Builders need to consider the lifetime and operating costs.

Accessibility for Maintenance



Ventilation system inlets must not be located in areas where they can draw contaminated air into the house. That is why they should not be located over gas meters, near garbage can storage areas, at driveways where cars may idle, or less than 18 inches above the ground. But they should be located somewhere accessible.

The inlet vent grill in this example shows the condition of the insect screen on the intake about eight months after cleaning. Various insects, especially spiders, find these areas great feeding stations, so they weave their webs that in turn allow a build up of material, including grass clippings if the vent is near the ground. Depending on the amount of life in the local environment, the entire insect screen can plug up very quickly, thus shutting off any fresh air entering the house.

Inlet vents should always be accessible for periodic cleaning. The example shown here is 8 feet above the ground, making it awkward to get at for easy maintenance.

Impact of a Healthier Home Environment

André Fauteux

Anecdotal evidence continues to mount that healthier homes are beneficial for health. The recipe is simple: reduce pollutants and ventilate.

For years, Linda Linders of Dartmouth, Nova Scotia was gasping for air. A severe asthmatic, she spent up to six hours a day receiving medication through a mister and was regularly hospitalized for pneumonia. Being outside with her three children was difficult in Dartmouth because of the high proportion of wood heating used in the neighbouhood. She found it necessary to return home often because of difficulty breathing. She said "It's like having someone sitting on your chest. It's pretty scary: you're gasping for air.'

Today, she feels like a new woman. As she puts it, "I haven't had a cold in two years and gave the mister to my brother. It's funny: I'm actually starting to take my health for granted!"

Her near-miraculous recovery happened six years ago, after her family moved into a neighbourhood of R-2000 homes. Her house includes a dry, mould-free basement (thanks to proper rainwater drainage), hardwood and ceramic floors, very little carpeting (which can act as a sink that accumulates and emits allergens and irritants), a central vacuum cleaner exhausted to the exterior, a heat recovery ventilator that provides continuous fresh air to every room, a high-efficiency particulate filter, and superior insulation and airtightness.

Six months after moving in, she felt so much better that she could reduce the dosage of medication. "If I ever moved, I would want a house with all the features of an R-200 home. Otherwise, I'd be afraid to get sick again" she said.

R-2000 healthier housing is increasingly the treatment of choice for asthma, a chronic inflammation of the airways. Allergens such as dust mites, cat hair, pollen and moulds are the most common triggers of asthma attacks. Experts say better diagnosis (many people don't realize they have mild asthma) only explains a small part of the huge increase in prevalence.

According to Statistics Canada, asthma killed 411 people (98% of them adults) in 1997. It strikes 6% of Canadians aged 15 or older. Even more worriesome, the prevalence of childhood asthma has more than quadrupled between 1978 and 1994, when it struck 11% (700,000) of Canadian children. Asthma affects a record 14% of kids in Atlantic Canada and Quebec ranks next with a 12% rate. Parental asthma and a history of bronchitis and allergies are associated with a greater risk of child asthma. StatsCan also suspects that parents of asthmatic children are underreporting their smoking habits.

Indoor air pollution blamed

Since the 1980s, outdoor air pollution has declined thanks to strict regulations on vehicle and industrial emissions. The asthma epidemic is increasingly blamed on interior pollution trapped by tighter building envelopes and inadequate ventilation. Excessive moisture, which feeds moulds (that can affect the immune system) and dust mites, is much more dangerous than previously believed. Harvard University researchers have found that an indoor relative humidity greater than 45% in the winter increases prevalence of respiratory problems.

Canadians have made their homes more airtight since the 1973 oil embargo and the trend is continuing, especially as global warming is being linked to fossil fuel combustion. But tighter homes can actually improve indoor air quality if they are fitted with central mechanical ventilation. It is only by having controlled ventilation that we can filter incoming air and minimize uncontrolled entry of outdoor pollutants that are allergens and irritants.

Old houses aren't ventilated

The need for, and principles of mechanical ventilation were recognized as far back as 1976 in the Saskatchewan Conservation House in Regina, ancestor of the R-2000 Home. Unfortunately, that recommendation and need have too often fallen on deaf ears.

Even leaky old homes need effective mechanical ventilation in every room. Opening windows year-round just won't do. Many people are just not getting enough fresh air to support the healing that should come with sleep, because often there is no wind nor a large enough pressure difference (created by indoor/ outdoor temperature difference) to get enough natural air flow.

According to a study by Danish doctor Jens Korsgaard, lowering the interior humidity using a heat-recovery ventilator can cut asthma drug expenses by 60%.

Source control

Controling sources of pollution is the first priority, even before ventilating. Jim White, CMHC's former chief researcher, notes that children's food, air and water, even their mother's milk, is contaminated with chemical and biological toxins, so we should not be surprised if they get sick. He notes that even many low-VOC and even 'no-VOC' paints and caulks are loaded with highly toxic compounds that any test would show can be expected to cause cell alterations, nervous or immune system disfunction, and even cell death. Since the public does not ask for low-pollution materials, few are being produced (with some pleasant exceptions) and their use is not being mandated.

While the R-2000 Home program lists lower-emission materials that builders can choose from, it is important to note that household cleaners, so-called air freshners and dry cleaning solvents emitted from clothing can be the worst offenders. A recent study found that the indoor air quality in new R-2000 houses is superior to that in conventional ones, but six months after occupancy, the difference was not as pronounced because of how the occupants used and furnished their homes.

That is why it is appropriate to include storage cabinets for household chemicals that are vented to the exterior.

Wood heating

An ongoing study in Prince-Edward-Island has found that the most effective predictor of visible mould is the amount of wood used for heating. Many stoves spill (otherwise you wouldn't smell the smoke), and spillage contains water vapour that can condense in colder parts of a house, such as under poor-quality windows. The combination of smoke and mould particulates is much more likely to cause respiratory disease than either one contaminant on its own.

CMHC has many excellent publications on indoor air, including the 238-page guide Building Materials for the Environmentally Hypersensitive.
CMHC publications: 1- 800 - 668-2642.

CMHC Studying Effects of Home Improvements on Asthma

A recent pilot study by CMHC and Health Canada has found that the better you eliminate the causes of a moldy basement, the greater the chance of lessening asthma symptoms. It is important to meticulously clean up the mould and to correct the source of moisture (such as chronically damp foundations) so that the mould does not come back.

The study tested the air quality of five houses containing toxigenic moulds before and after home improvements. In two houses (where the moisture entry through foundation walls was not stopped) it was found that a ventilation system combined with use of a dehumidifier and air conditioner did not prevent the recurrence of the mould. If the house is severely contaminated with moulds, a ventilation system will not do anything.

Although the pilot study was too small to be conclusive, it is laying the groundwork for a larger study that will include 20 non-smoking (no exceptions) families with at least one asthmatic member.

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

Technical Research Committee News

Canadian Home Builders' Association

The Technical Research Committee is unique in that it brings together most participants in the Canadian housing industry around the same table to discuss issues of common concern. As issues arise that may have an impact on other sectors, it offers an opportunity to bring all relevant parties together to undertake whatever research may be needed to resolve problems. This reinforces the principle behind Canadian housing technology that a house is a system.

Solplan Review aims to cover activities at the TRC. Usually, we can only highlight a few issues. We thought it would be interesting for readers (and CHBA members too) to see the broad scope of activities that are on the agenda at the present time. In some activities the TRC is only monitoring activities for potential impacts on house construction. Some involve more direct participation. Others are information activities to communicate information to the building community.

This is a good time to remind you that if you encounter a specific problem or need more details on these or any other building industry issues, contact the TRC. Queries from the field are a good way to pick up on emerging issues. It could be that your concern is not isolated, and others may have similar problems.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association,
Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
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Fax: (613) 232-8214
e-mail: chba@chba.ca

Ventilation: there have been many problems implementing new Code requirements for ventilation. Code revisions are underway as well as information on how best to comply with the new requirements.
Moisture Induced Envelope Deterioration
Builder Liability - Australian Experience. A review of Australian experience with regulatory reforms.
Advice to Builders on Managing Risk. CHBA is developing a guide for builders on managing risk
Fire Resistance Testing of Floors and Walls in Houses.
Engineered Floor Systems
R-2000. The program remains a key vehicle for innovation and quality improvement in new home construction.
Built for Living. Consumer information materials to increase consumer awareness about environmental issues in housing.
EnviroHome. A marketing initiative based on the R-2000 program.
Builder Manual currently being updated.
National Action Plan on Climate Change. Participation on the Buildings Table which is charged with developing a strategy to reduce green house gas emissions in the residential sector.
Home Energy Assessment Service (ENERGUIDE for Houses)
Model National Energy Code for Houses
National Building Code Revisions
Objective-based Codes. Current re-examination of the National Building Code (with respect to the intent of its requirements) will have a significant impact on the format of the code.
Codes and Standards Committees. CHBA is represented on many standards committees.
National/Provincial Code Developments and Review Process. There is a move towards an integrated code development process to reduce duplication and inconsistency in codes across the country.
Guide to Application of Part 9 to Existing Buildings
Separate Building Code for Houses
Canadian House Code and Illustrated Guide
Stucco. Suggestions have been made to change the requirements for stucco application in the NBC.
Termites. There have been proposals made to require termite-proofing in new areas of B.C.
Balustrades - Strength Requirements. Work with the Canadian Wood Council to develop a less stringent interpretation of the strength for pickets in residential balustrades.
Bannister Height Requirements
Mandatory Sprinklers CHBA is fighting the disinformation campaign being waged by the sprinkler lobby.
Smoke Detectors
Seam Telegraphing
Foundation Design and Construction
Fire and Acoustic Separations in Apartments
Emissions from Building Materials
National Technical Guide for Municipal Infrastructure. The National Research Council is developing a best practice guide to assist municipalities in maximizing the return on their infrastructure investment.
Canadian Centre for Housing Technology
Sulphate Resistance in Concrete
Steel Door Performance
Advanced Integrated Mechanical Systems (AIMS)
Contaminated Lands
ACT - Overcoming Regulatory Obstacles to Innovation
Innovation in the Construction Sector
Healthy Housing. Brings together research findings on indoor air quality, moisture and mould, energy efficiency, embodied energy, emissions testing, waste reduction, etc.
FlexHousing. Information initiative bringing together research findings for persons with disabilities, housing for elderly persons and changing house needs.
Site Planning and Development
Private Inspection Industry
CMHC Home Owners' Manual
CMHC Research and Information Transfer Initiatives
Publications and Seminars. Promoted the dissemination of information relevant to builders through a number of initiatives, including Solplan Review.
National Housing Research Committee brings together federal provincial and non-governmental agencies to identify research needs.
Pulse Survey. A survey of CHBA members on issues of concern and plans for the coming period.
Liaison with Industry Partners to cultivate strategic alliances with important industry associations.
Industrial Research Assistance Program (IRAP)
CHBA Web Site Development and Maintenance
Information 'Roadmap' that will make is easier for members to find technical information when they need it.
North Committee. A group that focuses on technology development in northern and remote locations.
Provincial HBA Research. Support for projects identified as priorities in specific regions.
False Advertising. Concerns have been expressed about unsubstantiated claims made by some product manufacturers.
Major Industrial Accidents Council of Canada (MIACC)
Consumer Health Issues. Research on occupant health.
Alternative Materials and Assemblies. Information on new products and approaches to building.
Airport Noise
Sustainable Communities.

Construction Practices for Engineered Wood I-Joist Floors

Don Onysko

Engineered wood I-joists for floor construction give builders products with unique properties. Some jurisdictions require all designs using these to be engineered while others do not. In cases where special engineering design is not required, builders accustomed to building traditional solid sawn lumber floors may not be aware of the differences that have to be accounted for. Some of those differences are highlighted in this article.

The important differences

Engineered wood I-joists have structurally more efficient cross sections for bending strength and stiffness than do rectangular cross sections. There is more material in the 'flanges' because that is where the member can be stiffened and strengthened. Wood I-joists can be supplied in more depths and longer lengths than lumber joists. As well, wood I-joists are manufactured dry, so shrinkage and other dimensional changes are minimized.

The efficient cross section in wood I-joists is created by using thin OSB or plywood webs designed mainly for carrying floor loads. The webs are not designed to carry loads from the upper stories and roof of a building without additional framing. Sometimes stiffeners are needed to keep the webs of deep joists from buckling at bearing supports or at other point loads. With some high point loads, squash blocks or other supports are needed to prevent the web knifing into the flanges.

Shrinkage and compression

In traditional platform construction, the lumber rim joists and headers provide the extra bearing area needed to carry the load from the upper floors and the roof. These loads rest on the floor platform below. The rim joists are the same size as the floor joists and are usually at about the same moisture content. When they dry, they all shrink and share the loads together.

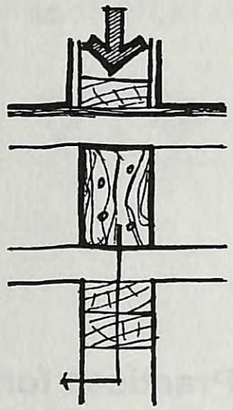
Wood I-joists are dry when supplied, so they should not be used in combination with lumber rim joists or headers because these shrink and compress differently. Mixing lumber joists and wood I-joists should be avoided: proprietary rim joists are available for this purpose. These rim joists are similar in appearance to thick OSB "lumber" and are pre-built for use with a joist manufacturer's product. More depths for wood I-joist depths are available on the market than for solid lumber. However, even for identical depths (for example, 9¼" and 11 ¼") I-joist manufacturers discourage mixing the two products.

Bearing loads

When needed, squash blocks can be used to transfer loads from above and through the I-joists. Squash blocks should generally be 3 mm (⅛") shorter than the I-joist depth to ensure the load does not get applied to the top of the joist. The blocks are short lumber stubs that fit against the side of the flanges through which the load is transferred. At interior supports, overlapping the wood I's sometimes provides enough contact area and bearing capacity. But this must be checked to make sure if the capacity is sufficient.

Web stiffeners and squash blocks are not normally pre-installed. They must be installed on site

Always refer to manufacturer's literature for specific installation details.



Web stiffener attachement (side elevation)

Web stiffener (section) nail to joist web from each side, per manufacturer's recommendation.

when the exact support locations are known. If left out for later installation, squash blocks can be difficult to insert, besides making the structure unstable during installation.

Lateral stability to resist wind, earthquakes and foundation pressures.

Traditional lumber floors have relatively good lateral stability. The stocky cross sections are held upright by perimeter rim joists, bridging and blocking, and with good nailing, usually act like rigid plates or diaphragms to transmit lateral forces. So too do engineered wood joist floors - if they are installed properly. Their slender cross sections make it more important that the details used provide the needed lateral bracing. Rim joists help to provide the bracing to the floor or foundation below.

Some manufacturers do not recommend using conventional cross bridging partly because it might not be applied effectively. Any special recommendations should be followed. Altering the direction of the floor joists in different parts of the floor plan can also provide additional lateral resistance.

Hangers

Wood I-joists can also be supported from bearing walls by means of hangers. Special hangers are needed for use with wood I-joists. Web stiffeners may be needed so the joist ends do not twist in the hangers, and to prevent splitting of the flanges. Conventional wood joist hangers must not be used.

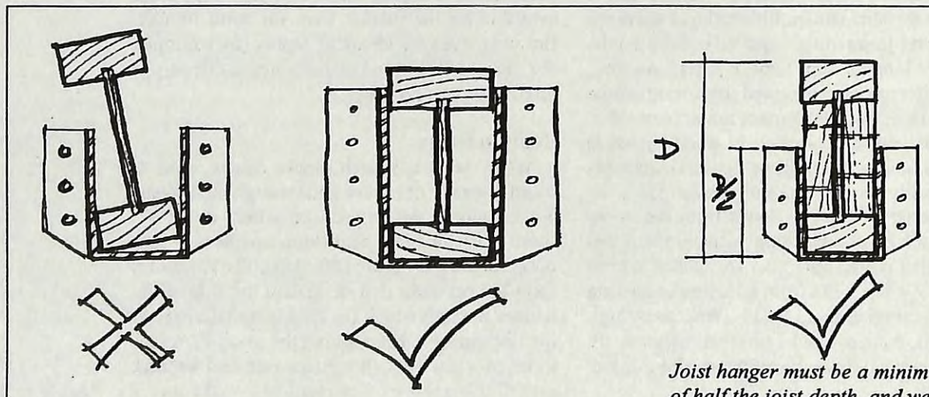
Some builders have experienced squeaking at hanger bearings. Using the correct number and size of nails supplemented by elastomeric adhesive in the saddle minimizes the problem for both wood I-joists and lumber joist floors.

Holes

An advantage of an I-cross-section is that it is not significantly weakened by cutting holes through the web. This enables builders to string piping and ducts through the floor as needed. However, there are restrictions in the size, location and shape of holes that can be cut. Always refer to the manufacturer's literature for guidance on allowable hold size and location.

Installation details and training

Many details suitable for wood I-joist construction can be found in the manufacturer's installation manual. Installers must be familiar with the positioning and size of allowable holes, bearing stiffener installation, squash block details, designs for hangers, and cantilever joists. Training courses can be provided for framers through a local CHBA technical committee, and the wood I-joist industry. For more information on the proper details to use, read the individual manufacturer's literature available where wood I-joists are sold, or contact the manufacturer directly.



Joist hanger must be a minimum of half the joist depth, and web must be stiffened.

Top and bottom flanges must be restrained against rotation

Always refer to manufacturer's literature for specific installation details.

BUDMA: International Construction Trade Fair, Poznan, Poland

Travel, they say, is enlightening. Today more people than ever are scanning the globe for business opportunities. I'm surprised at the number of even small builders who are tackling projects in far off lands - projects sometimes no bigger than a single-family house.

Before contemplating work overseas, it is important to assess foreign markets with care. The key to success usually means a thoughtful analysis of local conditions. Although there may be code and regulatory obstacles, these are often minor if the technology proposed is sound and has the proper certification at home. In some markets, there is already an understanding of Canadian standards and acceptance of Canadian technology and products.

More important is the human interaction and relationships that get the contracts in the first place. In many countries business is done more personally than in North America, where often an amount on a piece of paper is enough to secure a contract.

Anyone contemplating foreign business ventures better do their homework. A starting point could be the export centre at CMHC, which provides assistance and market research information for members of the Canadian housing industry interested in overseas work. CMHC works with External Affairs through their network of commercial attachés, and can provide valuable information on local markets and assistance opening commercial doors.

Another approach is to travel to the region you are considering and assess the situation in person. Attending local trade shows is also an excellent way to get a feel for the region.

I recently had the opportunity to attend the BUDMA show in Poznan, Poland, to make a presentation on Canadian building technology. I must say the show opened my eyes. As large as this show is, it is only ranked number 5 in Europe in terms of attendance.

Europeans historically have relied on trade shows for much of their networking and marketing. The BUDMA show, which only deals with construction materials, had more than 1,500 exhibitors (from 26 countries) and received some 70,000 visitors over 5 days. The fair grounds where the show was held were immense - the exhibit area itself covered 58,000 m2 (624,000 sq.ft.) spread over 20 buildings in an area that resembled the Pacific National Exhibition in Vancouver or the Canadian National Exhibition in Toronto in size.

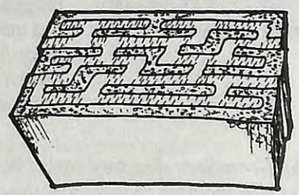
More astounding was the realization that, because this was a building materials show, there were no plumbing fixtures, heating equipment or lighting on display - these have their own shows. In comparison, the NAHB Builders' Show in the USA has about the same number of visitors with about 1,000 exhibitors showing plumbing and mechanical equipment. (The largest trade fair takes place every two years in Paris, and has an attendance of around 500,000!)

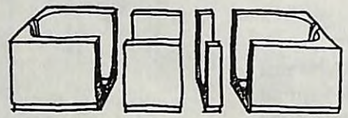
Exhibits at BUDMA are grouped by themes. For example, if you are interested only in windows, you need only visit three buildings; if you want doors, there are two buildings with doors and door hardware; if you want insulation and caulking products, a separate three level building has nothing but.

With traditional European flair, most of the displays exhibited a sophisticated level of design. The typical 10 x 10 or so North American trade show booth full of products appears tawdry by comparison. Because the show is the venue for a lot deal making, many exhibitors incorporate conference rooms and bars (where they serve not only coffee but draft beer and other beverages). A very civilized way of doing business.

Big as the show was, were there any highlights? Given the high price of energy, and rebuilding that has to be done in post communist central Europe, it is not surprising that insulation is a very big item. Since masonry construction is the dominant tradition, foam insulation products are widely used.

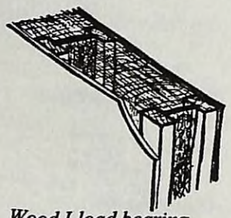
Insulated concrete forming systems (ICFs) are not big yet. However, attempts at making masonry construction thermally effective abound. One block system developed in Poland is a lightweight concrete block cast around a maze of expanded polystyrene to reduce thermal bridging and increase the insulating properties of the block. (Each block has a total of about 185 mm of expanded polystyrene insulation, for a nominal R-value of about 6).





Bathtub foam block support. middle sections can be trimmed to suit specific tub size

One interesting product that an enterprising person could consider introducing here is an expanded polystyrene foam support for bathtubs. Rather than building framing around the bathtub to hold it in place, then installing plywood to support the tile surround, this company cuts EPS blocks to support the tub. In this way, a foam block supports the tub and provides the backing for the ceramic tile surround. As an added bonus, the insulation keeps the tub warmer so the water will not cool down as fast.



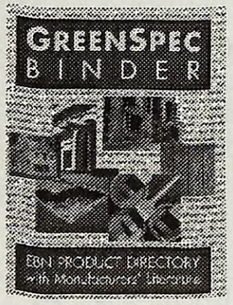
Wood I load bearing studs

Although Poland has a tradition in masonry construction, timber framing is well known in some regions. About 4,000 housing units are built in wood frame (in a housing market of around 150,000 units). In recent years there has been interest in North American style 2x4 wood frame technology. Canada's image of quality is associated with the idea of wood-frame house construction, which is known generically as "Canadian" construction regardless of its country of origin. Several Canadian companies are taking advantage of this, and are in the market there, either selling materials or entire housing units.

It was interesting that a local engineered wood products manufacturer, who uses recycled wood content in their products, has developed not only wood-I joists but also wood-I studs for use as a structural framing member. The idea has been around for a while, and was used in the Waterloo (Ontario) Advanced House in 1993, but they had to use the floor joist materials. Not too many manufacturers have taken the effort to develop engineered I studs. The benefit, of course, is a more efficient structural way of using wood fibre products, and reduced thermal bridging through wood framing.

When we look at doors, we tend to focus on the design of the panels, the finish, and colours. Not too often do we consider that the standard square edge door panel design we have become accustomed to might have taken things too far, especially for an exterior door. Air sealing the door is not easy to achieve - that falls on the weatherstripping and gaskets that may be fitted to the door and on the frame itself. In Europe, a common standard door design is a rabbetted door panel, which makes possible a double compression gasket, and a much more airtight door.

"Green" Building Materials Directory



The environmental challenge we face means we must maximize use of environmentally appropriate design materials and construction techniques. Often the challenge is to know which products and systems improve the environmental performance and energy efficiency of buildings.

Many suppliers make claims for their products as being "green" or environmentally friendly. However, just what is it that makes a building product green? Criteria can vary and depends on a range of factors. Until impacts are fully quantified, and until one can easily weigh the impacts of one product against those of another, evaluating the relative "greenness" of building products will depend on judgement by knowledgeable experts.

For any green building product directory to be useful, users must understand why a product is included and trust the integrity of the selection process.

The publishers of Environmental Building News have introduced the GreenSpec product directory. This guide includes detailed information on more than 1,200 screened products. To be included in GreenSpec, products have to offer environmental benefits compared to conventional products. Because there are many areas of potential benefit, the process of selection can get quite complex.

The criteria used to evaluate products in the product directory have also been published as part of the directory. We have included a summary of the Green Spec Standards (Table A).

Guidelines for product inclusion will be refined over time, as understanding of the issues increases, and as suppliers improve their products.

***The GreenSpec directory** costs US $79.00 plus shipping. (A binder that also includes product literature is also available).*
Tel: 800 - 861-0954 Fax: 802-257-7304
e-mail info@greenspec.com www.greenspec.com

Letter to the Editor

Solplan Review does an excellent job of covering the complete construction industry.

In the most recent issue (Solplan Review No. 90, January 2000), it was hard to understand where all the parts went together. If possible, a cut away diagram would have helped in explaining where the different air barriers get used. Here in Ottawa, I usually see Tyvek wrapping sheathing as the exterior air barrier. The article mentioned drywall as an air barrier, does that mean the use of drywall on the exterior or that the air barrier can be on the inside wall?

Marc Grondin
Ottawa, ON

Thanks for the comments. Unfortunately, showing all details is not always possible, as there may be many combinations possible. As the article mentioned, there are many ways different materials can be combined to make an airtight building envelope. The air barrier can be anywhere in the envelope - inside, outside, or partway in the wall. The important thing to keep in mind is that materials in contact with each other must be compatible and installed properly. The moisture permeability must also be considered, so that impermeable materials are not installed where they may be at a temperature that is below the expected dew point.

Where drywall is used as an air barrier, it is normally on the inside of the exterior wall. Interior drywall will deteriorate when wet, so it cannot be used outside. Only exterior type drywall (commonly used in large-scale commercial construction) can be used on the outside of the framing. Exterior drywall is not the same as that used indoors, and is treated against moisture damage.

The principal intent of any sheathing membrane behind the exterior cladding is to be a weather barrier to keep moisture that might penetrate the exterior cladding from getting into the construction. The weather barrier may be the traditional building paper, Tyvek, or any other proprietary sheathing membrane. Tyvek and the other proprietary products are also often used as air barriers, provided they are applied carefully and all joints are sealed.

Table A

Building Materials: What Makes a Product Green?

Summary of Product Standards for GreenSpec

1. Products made from environmentally attractive materials
- *1a. Products that reduce material use*
- *1b. Salvaged products*
- *1c. Products with post-consumer recycled content*
- *1d. Products with post-industrial recycled content*
- *1e. Certified wood products*
- *1f. Products made from agricultural waste material*
- *1g. Natural or minimally processed products*

2. Products that are green because of what isn't there
- *2a. Alternatives to ozone-depleting substances*
- *2b. Alternatives to products made from PVC and polycarbonate*
- *2c. Alternatives to conventional preservative-treated wood*
- *2d. Alternatives to other components considered hazardous*

3. Products that reduce environmental impacts during construction, renovation, or demolition
- *3a. Products that reduce the impacts of new construction*
- *3b. Products that reduce the impacts of renovation*
- *3c. Products that reduce the impacts of demolition*

4. Products that reduce environmental impacts of building operation
- *4a. Building components that reduce heating and cooling loads*
- *4b. Equipment that conserves energy*
- *4c. Renewable energy and fuel cell equipment*
- *4d. Fixtures and equipment that conserve water*
- *4e. Products with exceptional durability or low maintenance requirements*
- *4f. Products that prevent pollution or reduce waste*
- *4g. Products that reduce or eliminate pesticide treatments*

5. Products that contribute to a safe, healthy indoor environment
- *5a. Products that don't release significant pollutants into the building*
- *5b. Products that block development and spread of indoor contaminants*
- *5c. Products that remove indoor pollutants*
- *5d. Products that warn occupants of health hazards in the building*
- *5e. Products that improve light quality*

Energy Answers

Rob Dumont

You can contact Rob Dumont at robdumont@hotmail.com with your energy related questions.

In your last column you stated: "Commercial buildings are leaky, and for the most part newer buildings don't appear to be getting any tighter." Isn't that judgement too harsh? Aren't there are a lot of Canadian contractors now using high quality air barriers such as thermo-fusible membranes (torch-on membranes) and peel-and-stick membranes? Don't these products solve the problem?

"What gets measured gets controlled" was a statement made by a seasoned observer of human activities. Very few measurements are made on the air tightness of commercial buildings, and with no measurements, there is likely no control.

One of the great features of the R-2000 program is the insistence that houses be blower-door tested to ensure that the air tightness goal is being achieved. Houses fail R-2000 certification unless they meet the air tightness goal. Air tightness is measured and it is controlled.

We recently performed some air tightness measurements on a new institutional building under construction here in Saskatchewan. In addition to a blower door, we also used an infrared camera to diagnose leakage spots.

On paper, the building looked good. It was a steel framed building with steel stud walls, exterior grade gypsum board, a thermo-fusible membrane on both the walls and roof, rigid insulation outside the membrane on both the walls and roof, a mix of brick veneer and stucco on the walls and a thermo-fusible roof membrane. The one questionable detail was the projection of the top chords of the trusses through the wall membrane.

"There is many a slip 'twixt the cup and the lip."

In reality, however, the building was leaky in several major spots. The complicated built-up steel truss chords were difficult to seal where they passed through the wall air barrier. In addition, the thermo-fusible membrane had not been sealed to the concrete grade beam. When using an infra-red camera in conjunction with the blower door, the leakage in both these locations was very noticeable. We also noted some air leakage where the wall's air barrier joined the window frames. We did a quantitative measure of the airtightness of the building, and it was no better than conventional buildings built in the 1960s.

Air barrier membranes, in a way, are like polyethylene sheets. Neither leaks air, but air can leak easily around the perimeter of both air barriers and poly if they are not sealed to some other rigid member.

Air barrier membranes can work well as part of a system of providing air tightness. Used in isolation, however, the membranes are no better than polyethylene at providing air tightness. As with most things in buildings, it is the overall system and not the individual components that matter most.

Achieving good air tightness in a building is not just a matter of having good components. The interaction of these components with other members is critical.

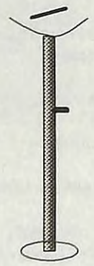
What do you think about torchiere lamps? They're cheap and almost everybody seems to have them.

Halogen torchiere lamps use either 300 or 500 watt lamps, which can reach temperatures of 1100 oF (600 °C) and can easily ignite paper, cloth, plastic or other common household materials. According to a recent article in Energy User News (February 2000), the halogen torchieres have caused at least 435 fires in the U.S., killing at least 32 people and injuring more than 114. Roughly 20 percent of U.S. college residences have experienced a halogen lamp fire of some type, and about 70 percent of colleges have banned the products in residence halls. All that has to happen is for someone to move the lamp next to a drape and ignition can readily occur.

In the U.S. there are 200 halogen torchiere fires that are in the process of litigation at present. In April 1999, the insurance companies for Wal-Mart and Cheyenne Lighting settled a single fire case for $11 million. Wal-Mart subsequently stopped ordering halogen torchieres for its 2,600 retail outlets and now sells compact fluorescent and incandescent models instead.

Some years ago there was an excellent article in Home Energy Magazine showing how you could fry an egg by locating a frying pan over top of the halogen torchiere lamps.

Here in Saskatoon a large part of an apartment building was destroyed when a halogen lamp fell into a sofa and started a fire. That no one was injured was a minor miracle.



Fortunately, there are now some alternatives to torchiere lamps. In our house, we have made an effort to eliminate most of the incandescent lamps by using compact fluorescent lamps or T-8 linear fluorescents. We have a couple of floor lamps that provide a light similar to a halogen torchiere, but the lamps use circular fluorescent bulbs that are much more energy efficient; using 25 watts instead of 300 watts. The lampshades are translucent, and the quality of the light is as good as that from a torchiere. And our drapes don't ignite from the hot bulbs.

From the Mouths of Babes . . .

"So many people today use energy instead of human power. Then, they buy exercise equipment because they are out of shape. Isn't that weird?"

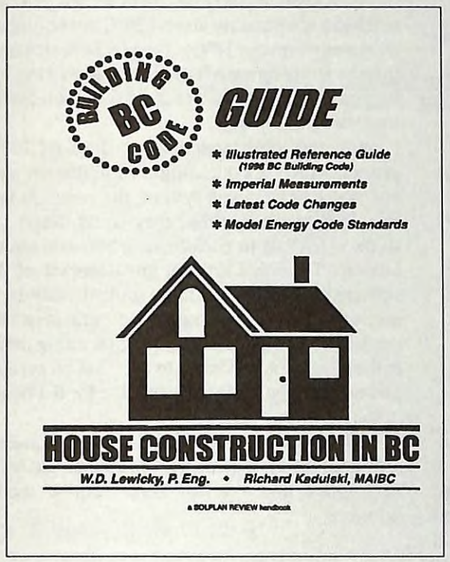
Sixth grader Jackie Reilly, Wisconsin

Mechanical Trades Marketplace Recognition

All construction trades are under assault from the "bottom feeders" - the tailgate contractors who work for the absolute minimum, and, from the big box piece workers. The Heating, Refrigeration, Air-Conditioning Contractors (HRAC) are planning to begin actively promoting its members in the marketplace as "contractors of choice".

The marketplace distinction program will build on the membership criteria that the association now imposes (criteria that include trade licenses, business and fuel safety licenses, workers' compensation and more).

Members in good standing will be promoted through a variety of information cannels, including local press, cable television and co-op advertising and also the Internet through referral arrangements with third parties.



A Simplified,
Illustrated Guide to
Residential Construction
in BC

House Construction in BC

by W.D. Lewicky, P. Eng. and Richard Kadulski, MAIBC

The illustrated guide to the 1998 BC Building Code explains Part 9 of the code as it applies to residential construction. This reference guide uses imperial measurements and explains code requirements with sketches where appropriate. The guide highlights the new code changes that came into effect on December 18, 1998.

Editorial comments are made to show where better practice can avoid problems, especially with building envelope detailing.

Also includes highlights of Model National Energy Code for Houses requirements for BC. (These standards are currently optional).

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Commissioning of CCHT Test Houses Shows Interesting Results

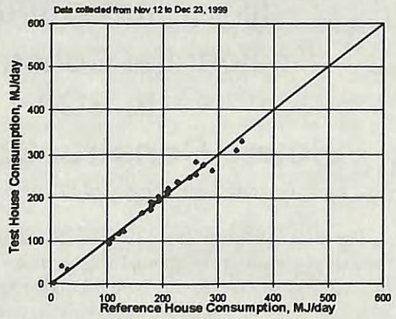
By Luc Saint-Martin

Luc Saint-Martin is business manager of CCHT.

During the fall and early winter, Mike Swinton, Research Manager of the Canadian Centre for Housing Technology (CCHT), and his team were busy calibrating and commissioning the centre's reference and test houses. This is for good reason because, to obtain accurate and significant results when evaluating a new technology in a test house, it is critical to ensure that it is operating as closely as possible to the reference house before making any changes. This meant weeks of painstaking work, looking closely at thousands of details from sensors to data acquisition system operation, temperature distributions, gas and electrical consumption of specific appliances and components, as well as hundred of on/off events of simulated occupancy.

Inevitably, something of this complexity can't be expected to go completely right the first time. There were glitches and a few mishaps, including a shower running continuously for almost 12 hours, but in the end, it was satisfying to see how closely the two houses perform as shown by the near-

Energy Consumption for Space Heating of the CCHT Research Houses



perfect fit of the 45-degree curve in the figure.

Some results were also surprising. For instance, the furnace fan is set to run continuously in order to achieve a more uniform temperature distribution in the houses. When fan electrical consumption is blended in with the total electrical consumption of the houses, few people may pay attention to the fact that running a 300-W motor over 24 hours accounts for over 7 kWh of electricity per day. That is about a third of the total daily electrical consumption of an average household. This raises the question of whether continuous fan operation is worth the additional comfort. Further investigation is this area could provide useful information.

Close monitoring also revealed, early in the commissioning work, that the furnace fan of one of the identical furnaces was consuming much more energy than the other fan. As it turned out, something had happened to that fan motor and it had to be replaced. Without the benefit of such sophisticated monitoring and comparison, a homeowner would never know where the sudden increase in electricity consumption came from or even know that the problem existed.

Cold sunny days also gave the CCHT team the opportunity to capture some interesting data on temperature distributions through south facing wall assemblies and on the inside and outside surfaces of the low-E, argon-filled windows. For example, the outside face of brick exposed to bright sun on a short January day with a high of -18°C, reached a temperature almost 36°C above ambient temperature (about 18°C). Researchers also noted that the temperature of the inside pane of the low-E, argon-filled windows rose over 40°C on some of those cold sunny days.

With the implementation of the first CCHT project, which is evaluating a combination space and water heating gas system, the research team was delighted to see that they could detect very slight variations in performance between the two houses. The sheer amount and accuracy of data collected allows trends to be plotted early in the project. CCHT is now poised to evaluate a large array of energy-saving technologies, either related to the building envelope or to mechanical systems, and to report on their performance for the benefit of the industry.

Mike Swinton will publish a more comprehensive account of the commissioning work in the near future and we will keep Solplan readers informed.

Glass name change

PPG has changed the name of their ***Sungate 1000*** low-e glass to ***Solarban***. This product is equivalent to Cardinal Lo-E squared glass.

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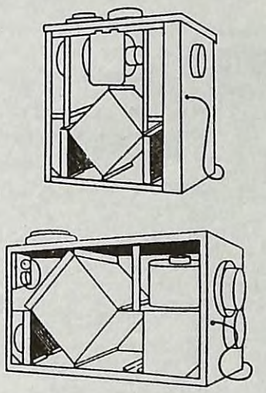

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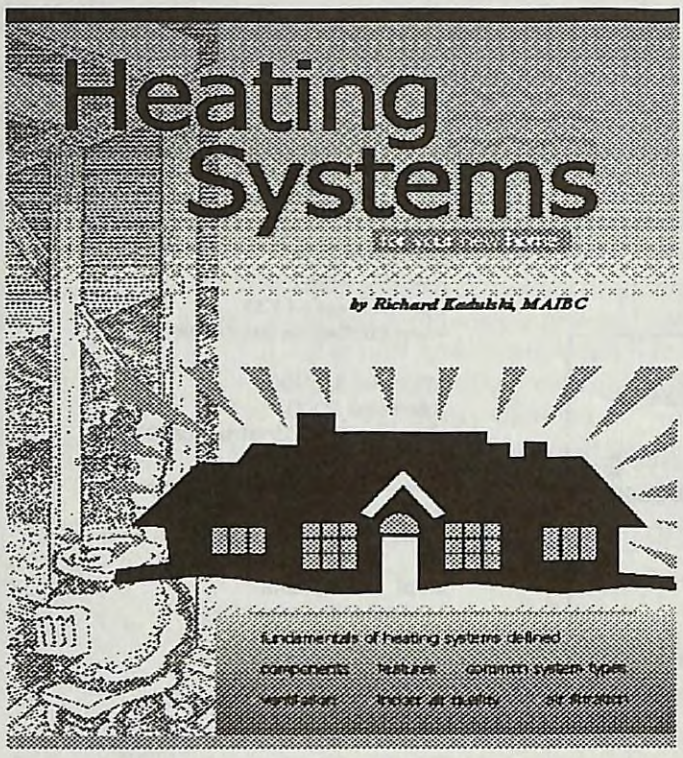

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